

ties, though only one individual has been able to secure related employment since the training program ended. Trainees reflect, "I had no prior work experience, so it has helped me." In Zuni, one youth is a program administration intern at Cornerstones. Another is now a housing program supervisor. Many are also now keenly aware that the National Park Service offers career development opportunities. While future opportunities appear to be based on the program's success, many community members and participants observed that an important dimension of the program is that it builds confidence and a positive and responsible work ethic, skills which will inevitably lead to employment opportunities.

Cornerstones views its youth training programs as pre-apprenticeship programs which orient young people to future career development opportunities. Results of these two programs will be incorporated into the future development of programs at new sites, with a goal of adding one new training site per year. The Pueblo of Zuni is in the process of incorporating the Cornerstones mentorship youth training program into their programs. The Mora community is continuing its youth training structures program this summer in collaboration with Cornerstones.

If New Mexico's rural buildings are to be preserved, and saved from apparent extinction, it is vital that rapidly dying traditional and culturally-derived building skills be passed along to future generations. As the elders in a given community grow older, the risk is high that the knowledge they have grown up with will die along with them if it is not shared with youth. The youth training program is not only important to a young person's future career development, it is a key component of a community's efforts to maintain and preserve important facilities, and the cultures and traditions these community symbols reflect.

*Barbara Zook, a former National Park Service historical architect, is Program Director of Cornerstones Community Partnerships, formerly the "Churches: Symbols of Community Project of the New Mexico Community Foundation." Since 1986, over 150 communities have received technical assistance about how to repair vernacular earthen buildings, and 41 communities have participated in Cornerstones assisted preservation projects.*

*Michael Kramer is an independent program development and youth training program consultant.*

Mark Starr

## Half-Hull Ship Models Unlocking Historic Ship Designs From Our Past

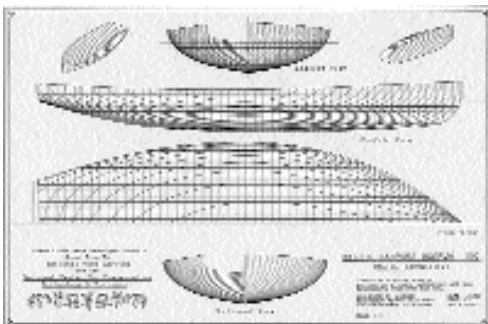
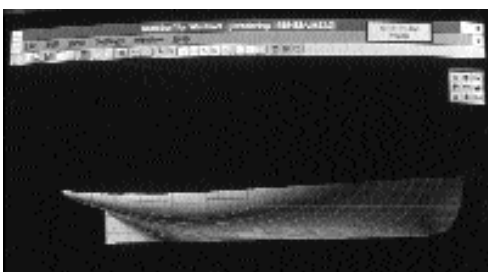
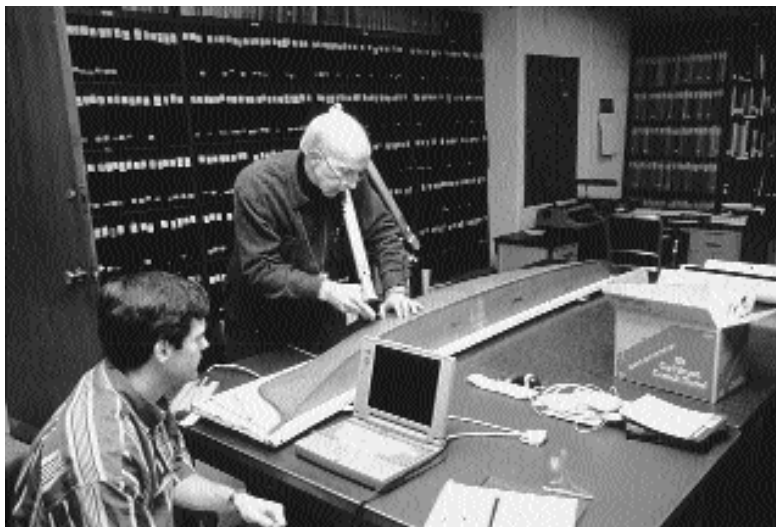
*Bob Allingham measuring a model from the collection at Mystic Seaport Museum. The photo shows the Faro Digital Arm and the laptop computer used to both run the machine, and to process the information gathered. The laptop makes the system more portable than would be the case with a full desktop computer.*

**H**alf-hull ship models are wooden models used by ship builders of the past to design in three dimensions the hull forms they would build. They can be found in great numbers spread throughout both maritime museums and private collections in the United States. Although these models make attractive wall hangings, they also represent a vast and largely untapped record of the history of American ship design over the past few hundred years. Given that most of these ships and their documentation are now lost, these models often represent our last ties to early designs. Their three-dimensional wooden format, however, keeps the information they contain unavailable to naval architects, scholars and boat or model builders. To make the information they represent useful once again, the models need to be re-measured



and re-drawn. Once they are converted back into lines plans, the information can more easily be compared and disseminated.

The stumbling block to converting wooden models back into paper plans has usually been manpower. The process of manually measuring and drawing half-models is typically very time consuming, and so these projects are not often undertaken. Because of this problem of time, and therefore expense, Mystic Seaport Museum, in association with the Smithsonian Institute and the Hart Nautical Museum at the Massachusetts Institute of Technology, began looking for alternate methods



*Faro arm measuring a model at the Smithsonian Institute.*

*Rendered view of the model surface with the planer sections cut through the model visible.*

*Photos and illustrations courtesy Mystic Seaport, Mystic, CT.*

that could be used to measure and draw the more than 1,600 models in their collections. It appeared as though one solution could come from the application of both new computer technology and modern measurement practices to the problem. The National Center for Preservation Technology and Training awarded the group with a grant to purchase the equipment and to train both staff and volunteers in its use. After receiving the

grant, we ordered both the equipment and the software and began the project.

We decided to measure the models with an arm type coordinate measuring machine, often used by machinists to check new components or to reverse engineer older parts. This type of measuring machine allows for a wide range of flexibility in the measurement of complicated hull forms. The arm itself moves much as a human arm does. Its six joints allow the point probe at the end of the arm to reach out and around the objects to be measured. The software keeps track of the rotation at each joint in the arm, and knowing the length of each section, does the trigonometry necessary to locate the tip of the arm in space. To collect three dimensional coordinate points, the operator places the tip on the point of interest and presses a button to record that point. Alternately, the probe can collect up to 30,000 points an hour in a stream mode if the button is held down as the probe moves through space. Planer cross sections can be

lifted from the object by using a software feature that locks onto a defined imaginary plane. The arm will then collect only points that lie on the plane as the arm passes back and forth across it. In measurements taken on models at Mystic, the machine has had a repeatable accuracy of approximately six thousandths of an inch over the length of the model. The typical electronic model of a half-hull usually contains six to eight hundred measured points, although very detailed models may have thousands of measurements taken. All of the coordinate data taken is stored directly on a laptop computer that runs the system.

After the three-dimensional coordinates have been gathered, they are converted into lines plans. This is done through the use of a naval architecture package by AeroHydro, Inc. called MultiSurf. This software allows for the creation of an electronic surface model of the wooden half-hull. Like the wooden object, the electronic surface can be sliced through with planes to reveal any cross section desired, such as those typically found in a set of lines plans for a vessel. To create this digital surface, electronic battens are run through sectional points and major boundary curves, such as the sheer, the rabbet line, the keel profile, and the transom outline. These battens, or splines, are then used as a skeleton over which the skin, or surface, is stretched. From there the computer is instructed to cut the surface into stations, waterlines, and buttocks (all of the cross-sectional cuts typically used to define a ship's hull form) for a set of lines. The process is similar to the way in which vessels are drawn by hand, except that the electronic model is in three dimensions. Any changes made to the hull in one view, such as the fairing up of the sheer, is automatically handled in the other two views, thereby saving the operator from constantly redrawing the changes. After dragging a point to a new location, the entire model is instantly updated to reflect the change.

Although we have used the machine primarily to measure hull forms, the machine can be used to measure any type of object. The arm comes in a variety of lengths, and can be leap-frogged down and around an object, linking all of the measurements into one unified coordinate system. Using this system, we hope to better document the half-hulls in existence both in museums and in private collections. This system also provides an accurate curatorial record of three-dimensional artifacts should some disaster strike.

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